Comprehensive quality assessment of GOME- and IASI-type multi-mission tropospheric ozone data records

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INTRODUCTION

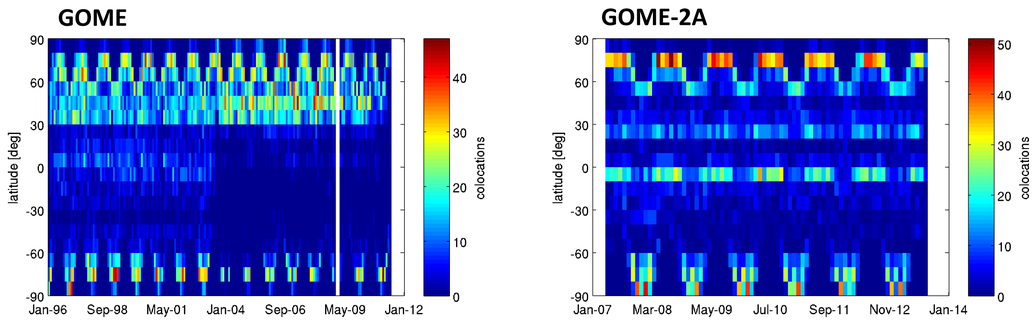
- Tropospheric ozone plays a key role in air quality and has a significant impact on the radiation budget of the Earth, both directly and indirectly.
- Tropospheric ozone observations are provided by two series of European nadir-viewing ozone profilers:
  - UV-visible spectrometers of the GOME type, launched regularly since 1995: GOME, SCIAMACHY, OMI, GOME-2 on MetOp-A/B/C, upcoming Sentinel-4/5/5p missions
  - Thermal infrared sounders of the IASI type, launched regularly since 2006: IASI on MetOp platforms and IASI-NG on MetOp-SG
- Several tropospheric ozone data products have been improved and harmonised in the context of the ESA's Climate Change Initiative (CCI) on ozone.
- To verify their fitness-for-purpose, we have applied to the Ozone CCI datasets a QA/validation expert system developed over years in the context of ESA's Multi-TASTE and CCI projects, EUMETSAT's O3M-SAF, and the European Commission's GEOmon and QA4ECV.

DATA SELECTION / CO-LOCATION / HARMONISATION

- GOME and GOME-2 nadir UV retrievals by RAL:
  - RAL v2.14
  - 20 fixed retrieval levels (VMR & ND) → 19 layers (PC)
- IASI TIR retrievals by ULB/LATMOS:
  - FORLI v20140922
  - 41 fixed retrieval layers (PC)

Satellite instrument	L2 ozone profile processing entity	Time period 96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
GOME	RAL	delivered																			
SCIAMACHY	RAL								expected												
GOME2A	RAL																				
GOME2B	RAL																				
IASI	ULB/LATMOS																				

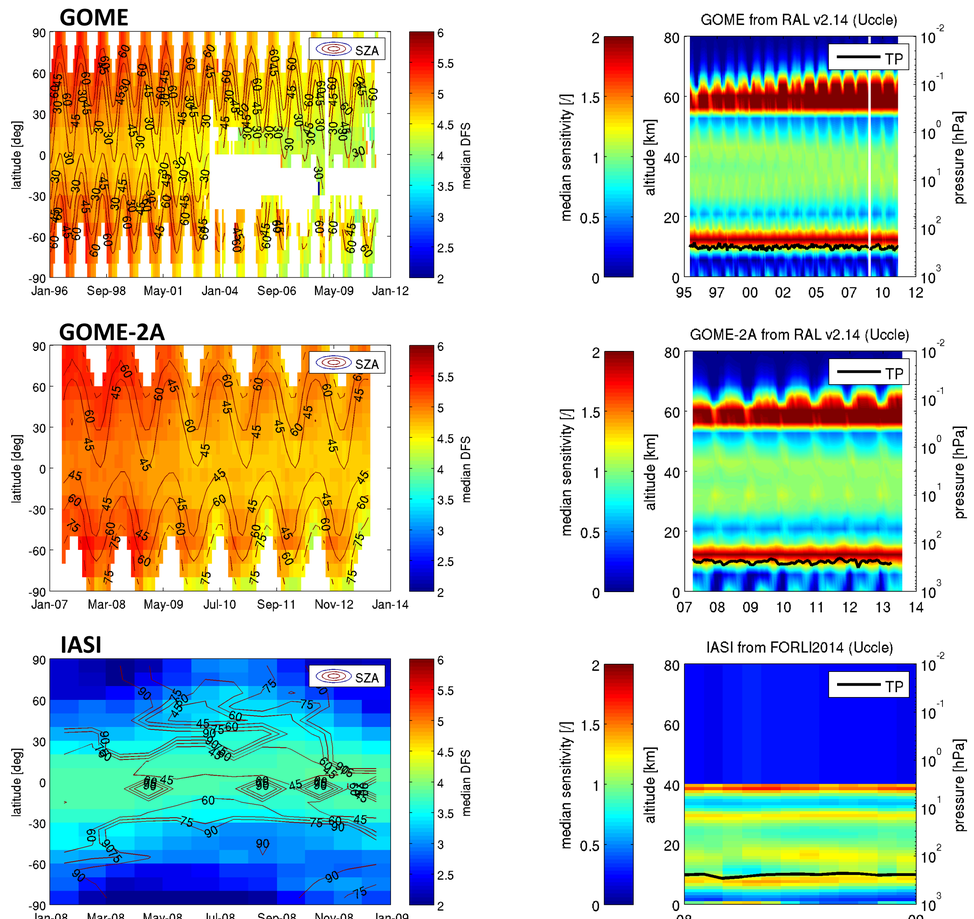
- 100 km and 3 h co-locations with ozonesonde data at 149 stations from WMO GAW contributing networks like NDACC and SHADOZ



- Mass-conservation regridding before optional AK-based vertical smoothing.
- Tropocolumn from direct summation over partial column profiles
- Two 'tropopause' products are considered:
  - Lapse-rate tropopause (LRT WMO def.) based on ozonesonde T profile
  - Fixed-level cut-off at 6 km (adopted within CCI)

INFORMATION CONTENT STUDY

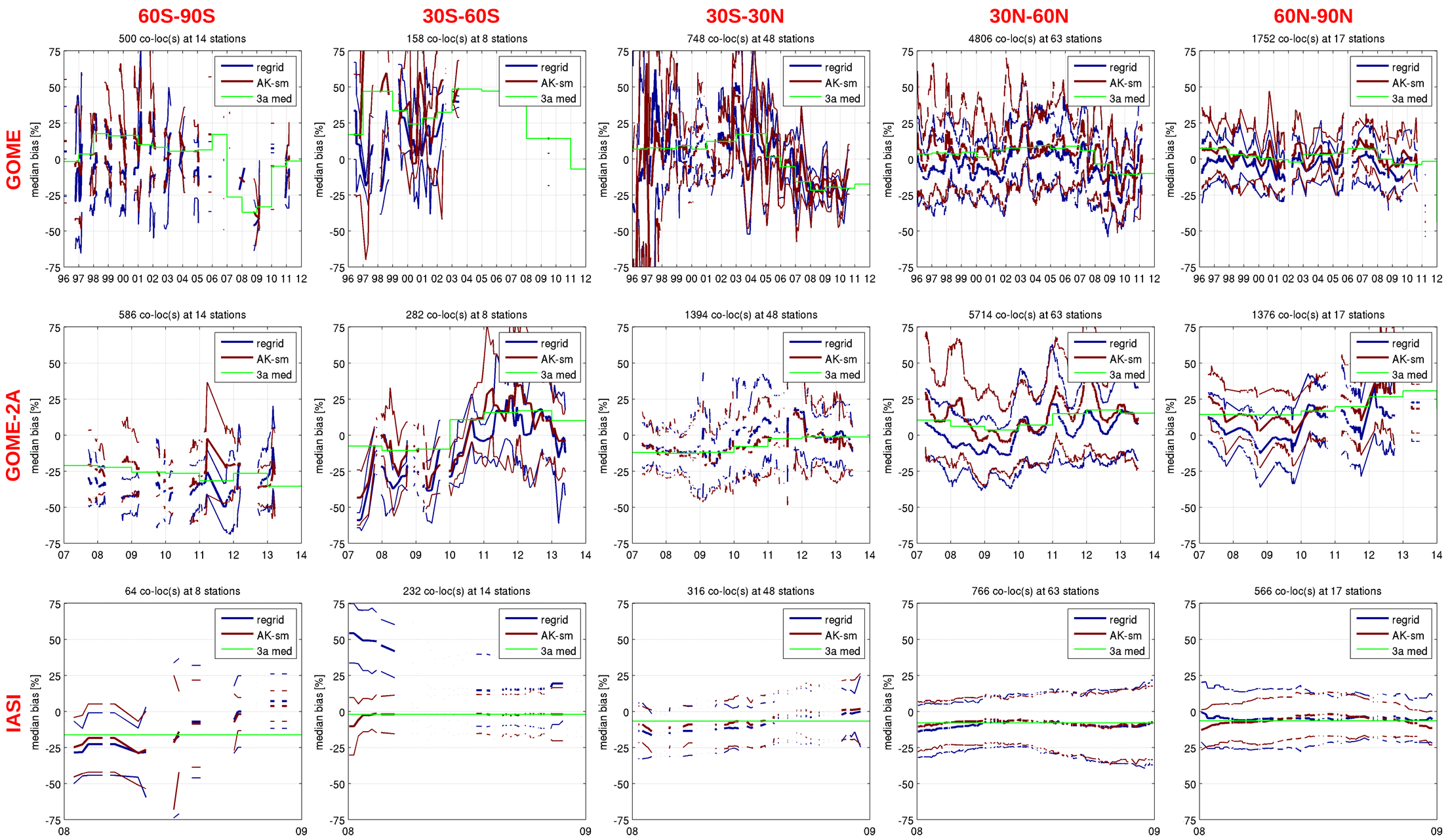
- From fractional averaging kernel matrices!
- Number of independent layers (DFS) shows meridian and temporal dependence.
- Variations of vertical sensitivity and other information content measures are directly related to slant column density (SCD), affected by solar zenith angle (SZA), latitude…
- Impact of instrument degradation on information content appears clearly.
- Poor sensitivity below tropopause (TP) increases tropocolumn uncertainty.



GROUND-BASED NETWORK VALIDATION

Half-year running median relative difference (thick lines) and 68 % IP spread (thin lines) for LRT-integrated tropospheric ozone column comparison with sonde network data:

- BIAS: GOME(-2A) bias of 10-25 % with stronger outliers, smaller (5-10 % negative) IASI bias due to higher sensitivity below TP
- SMOOTH: Impact of vertical smoothing up to same 25 % order as GOME(-2A) bias
- DRIFT: Pos. for GOME-2A, neg. for GOME, strongest drift for GOME at low latitudes (from 3-year median as green stairs for vertically smoothed data)
- TP-DEF: 6 km fixed cut-off bias (not shown) typically slightly larger, with amplified seasonal bias variation for all instruments



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